AMENDMENTS TO THE DRAWINGS

Submitted herewith please find two (2) sheets of replacement drawings in compliance with 37 C.F.R. § 1.84. The Examiner is respectfully requested to acknowledge receipt of these drawings. The submitted drawings are intended to replace Figures 1 and 7 of the drawings previously submitted.

Attachment: Replacement Sheets (2)

REMARKS

By this amendment, claims 1-74 are deleted and new claims 75-80 are presented for examination. The drawings are objected to because of various informalities

Claim 17 is objected to because of various informalities.

Claims 10-17 and 29 are rejected under 35 U.S.C. 102(a) as being anticipated by Baumgartner et al., Property Checking via Structural Analysis.

Claims 21, 24, 55 and 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baumgartner as applied to claims 10 and 29 above, taken in view of Jin Yang (U.S. Patent No. 6,643,827).

Claims 25, 26, 56, 57, 59 and 60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Baumgartner taken in view of Yang as applied to claims 24, 55, and 58 above, and further in view of Marques-Silva and Sakallah, GRASP: A Search Algorithm for Propositional Satisfiability).

The Applicants traverse the rejections and request reconsideration.

Claim 1-74 have been deleted rendering the above rejections moot. Claims 75-80 have been presented to more clearly define the scope of the invention. These new claims are supported at least by Figs.5-7 and the accompanying description. For example, Fig. 5 of Fig. 5, shows the latch interface abstraction. Fig. 6 shows latch interface constraints, and Fig 7. shows how the abstract model is generated using the combinational fanin cones of the marked flip-flops and marked external constraints.

The newly presented claims are distinguished from the cited references herein.

The primary reference Baumgartner uses a standard time frame expansion of a sequential design for verification purposes. This time frame expansion (also called an unrolled sequential

design), in general, includes latch interface constraints and initial state value constraints. However, the present invention focuses on checking whether these constraints belong to an **unsatisfiable core derived from a proof of unsatisfiability**, e.g. that provided by a SAT solver. In general, an unsatisfiable core contains many constraints. The present invention focuses specifically on these constraints, since they convey information about the relevance of a flip-flop in the proof. This provides an indicator for whether or not to keep the flip-flop in the abstract model.

Further, Baumgartner derives an abstract model by considering the combinational fanin cones of certain flip-flops and external constraints, and abstract away the other flip-flops as pseudo-primary inputs. Again, the main issue is how to determine which flip-flops to keep in the abstract model, and which to abstract away. However, it is not disclosed in Baumgartner as to how this is done. The present invention uses the unsatisfiable core from a SAT solver to make this determination, whereas Baumgartner does not use such information at all. The special characteristic of using the unsatisfiable core to make this determination is that it guarantees correctness up to depth *k* in the abstract model.

Yang et al. use a lazy fixpoint computation, and a lazy pre-image computation. The word "lazy" is a very generic term in Computer Science – it typically means that some computation is done on-demand. This is in contrast to an "eager" computation, which performs a computation whether or not it may be needed. The present Specification uses the term "lazy" as in "lazy constraint" and is very specific to how a logic constraint is propagated in a typical constraint satisfiability solver, such as a Boolean Satisfiability (SAT) solver. For example, a 1-literal constraint (m), where m is a Boolean variable, means that m should be set to 1, and this effect should be propagated to other constraints that may also contain the variable m (or its negation).

In a standard SAT solver (such as GRASP, cited by the examiner) 1-literal constraints are pre-processed, and their effect propagated "eagerly" to the other constraints.

In contrast to Yang, the present invention uses a "lazy constraint", to delay the effect of the propagation until when it is needed. In the present invention, a 1-literal constraint (m), where m is a Boolean variable, is replaced by constraints (m+y)(m+!y), where y is a fresh Boolean variable and !y denotes negation of y. Note that there is no effect during pre-processing, since the new constraints are 2-literal constraints (and not 1-literal constraints). Furthermore, the solution is still restricted to m=1, because if m is set to 0 by some other constraint, then there is an immediate conflict in the new constraints due to y. Thus, the restriction m=1 is ensured but lazily (if needed), not eagerly.

There is no discussion of this lazy propagation of constraints in either the work of Yang or the work of Marques-Silva [GRASP]. Only the word "lazy" may be used, but the specific computation considered is totally different.

Marques-Silva considers "immediate implications" in the GRASP SAT solver (FDAs on Page 510). Again, "immediate implication" is standard terminology in the context of SAT solvers. Whenever all literals but one in a clause are false, there is an immediate implication on the remaining literal. This rule, called the unit literal rule, is at the heart of most SAT solvers in practice. Marques-Silva proposed conflict analysis, where failure-driven assertions denote immediate implications due to conflicts. Marques-Silva also describes use of a (dummy) variable x_i (Page 518) in the context of FDAs and conflict analysis.

The present invention is not related to addressing failure-driven assertions or conflict analysis at all. The present invention aims to avoid immediate implications only in cases of 1-literal constraints that are added for representing (a) initial state values of flip-flops, and (b)

environmental (or external) constraints. The motivation is that if such implications are avoided, then these constraints are less likely to belong to the unsatisfiable core. This in turn, makes it less likely that certain flip-flops or environmental constraint nodes will be marked, thereby reducing the size of the resulting abstract model.

There is no discussion of unsatisfiable cores or abstract models based on unsatisfiable cores in the work of Yang or Marques-Silva.

Finally, McMillan [US Patent 6,944,838] uses an unsatisfiable core to generate an over-approximation of the set of reachable states (see Abstract). In contrast, the present invention does not generate any over-approximation of the set of reachable states.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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